

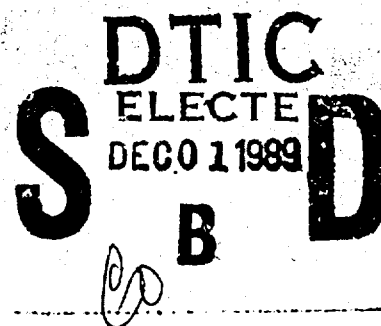
USAFSAM-TP-89-8

AD-A214 854

# TESTING OF THE MRL 450 SL-AF CARDIAC MONITOR

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August 1989



Final Report for Period November 1987 - January 1988

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USAF SCHOOL OF AEROSPACE MEDICINE  
Human Systems Division (AFSC)  
Brooks Air Force Base, TX 78235-5301



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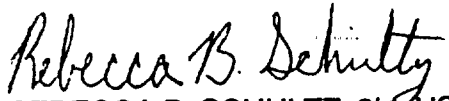
## NOTICES

This interim technical paper was submitted by personnel of the Chemical Defense Branch, Crew Technology Division, USAF School of Aerospace Medicine, Human Systems Division, AFSC, Brooks Air Force Base, Texas, under job order 7930-16-02.

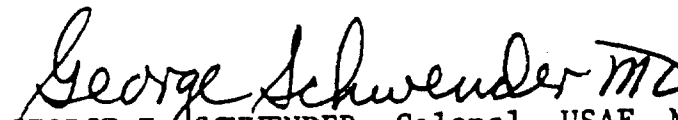
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The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

  
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# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) USAFSAM-TP-89-8			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION USAF School of Aerospace Medicine		6b. OFFICE SYMBOL (if applicable) USAFSAM/VNC	7a. NAME OF MONITORING ORGANIZATION		
6c. ADDRESS (City, State, and ZIP Code) Human Systems Division (AFSC) Brooks AFB TX 78235-5301			7b. ADDRESS (City, State, and ZIP Code)		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Headquarters, Military Airlift Command		8b. OFFICE SYMBOL (if applicable) MAC/SGNL	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code) Scott AFB IL 62225			10. SOURCE OF FUNDING NUMBERS		
	PROGRAM ELEMENT NO. 62202F	PROJECT NO. 7930	TASK NO. 16	WORK UNIT ACCESSION NO. 02	
11. TITLE (Include Security Classification) Testing of the MRL 450 SL-AF Cardiac Monitor					
12. PERSONAL AUTHOR(S) Randolph, William R.; Roy, Ernest G.					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM 87/11 TO 88/01		14. DATE OF REPORT (Year, Month, Day) 1989, August	
15. PAGE COUNT 16					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP			
23	01		Test and Evaluation; Cardiac Monitor; MRL;		
09	07		Aeromedical Evacuation; Electromagnetic Interference; (KT)		
19. ABSTRACT (Continue on reverse if necessary and identify by block number) The Aeromedical Equipment Evaluation Laboratory tested three MRL 450 AL-AF Cardiac Monitors for electromagnetic interference and susceptibility. All three units tested were within acceptable limits, and the 450 SL-AF was approved for use in USAF aeromedical evacuation aircraft. <i>repeated</i>					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Rebecca B. Schultz, 2Lt, USAF, BSC			22b. TELEPHONE (Include Area Code) (512) 536-2937		22c. OFFICE SYMBOL USAFSAM/VNC

# TESTING OF THE MRL 450 SL-AF CARDIAC MONITOR

## BACKGROUND

The USAF School of Aerospace Medicine (USAFSAM/VNC) initially evaluated the Medical Research Laboratories (MRL) Model 450 SL-AF Cardiac Monitor in March 1985 and found it acceptable for use on board U.S. Air Force (USAF) aeromedical evacuation aircraft. The 375th Aeromedical Airlift Wing, Scott AFB, IL, recently purchased twenty-three Model 450 SL-AF units. This report covers the electromagnetic interference test results on a sample lot (three) of the new units. It should be noted that the three units sent for evaluation already had the modifications detailed in our previous paper (1) on the Low-Profile Rigid-Mounted Cable Adapter. These modifications, a Ferranti transistor and shielded alternating current (AC) power supply cord, were made by the manufacturer and are standard items on all Model 450 SL-AF units with serial numbers above 2230.

## METHODS

The Aeromedical Equipment Evaluation Laboratory develops test procedures that cover safety and human factors issues which apply to the equipment to be tested. Specifically, a "performance check" is developed which is a procedure that verifies proper functioning of the equipment under various conditions. An initial inspection is performed by the Lab's BEMT (Biomedical Equipment Maintenance Technician). The BEMT checks battery charging characteristics, leakage current measurements, ground resistance, and any other measurements (i.e., temperature or pressure) necessary to verify that the device conforms to its specifications.

When the device has passed the initial inspection, it is subjected to various "referee tests" that check its performance under various anticipated operational conditions. The referee tests generally involve a repetition of the performance check under the specified conditions. Each referee test also includes any special measurements or procedures necessary due to the peculiarities of the testing conditions.

**Performance Check.** The performance check simply involved operating the MRL unit. A Medi Cal Instruments ECG simulator, Model 410, was connected to the 450 SL-AF via the standard patient ECG cable. A 120 bpm (beats per minute), 1 mV signal was applied to the monitor and all controls were set to maximum, except for the defibrillator and synchronizer which remained off. The units were individually tested on each power supply: 115 VAC/60 Hz; 115 VAC/400 Hz; 28 VDC; and battery.

**Initial Inspection.** Only leakage current and ground resistance were measured. A battery performance check was unnecessary. Heart rate accuracy, defibrillator energy

output and synchronization, and overall condition of the equipment were also checked.

EMI (Electromagnetic Interference). A performance check was accomplished during all phases of the Radiated Emissions and Conducted Susceptibility tests.

Vibration. Vibration tests were not necessary.

Environmental. Environmental testing was not necessary.

Altitude. Altitude testing was not necessary.

Clinical Testing. Clinical tests were unnecessary.

In-Flight Feasibility. In-flight feasibility studies were not necessary.

## RESULTS

No performance degradation was noted during the radiated susceptibility tests. The radiated and conducted emissions were within the acceptable levels specified in MIL-STD-461C, Category A1e (2). Figure 1 compares the EMI results between an unmodified unit and a modified unit.

The Appendix contains copies of the original EMI charts for the tests run on the three MRL units. Each chart shows the spectral frequency range tested for that unit. The dashed lines on the charts indicate the acceptable limit for that frequency.

## CONCLUSIONS

The new group of MRL 450 SL-AF cardiac monitors, with modifications, are approved for use on board USAF aeromedical evacuation aircraft. The three units evaluated had the modifications, a Ferranti transistor and shielded AC power cord, noted in our LPRMCA report (1). The AC power supply cord was clearly labeled as EMI shielded. However, we recommend placing a warning notice on the unit and in the operation/service manual, warning that a shielded cord must be used on the monitor in the interest of flight safety. If the AC power supply cord is not clearly labeled, shielding can be verified by removing the hospital grade plug and examining the ground pin connection for two wires. One is the electrical safety ground; the other is the AC power cord shield connection to ground. Replacement shielded AC power supply cords, Part #2086, can be obtained from the manufacturer.

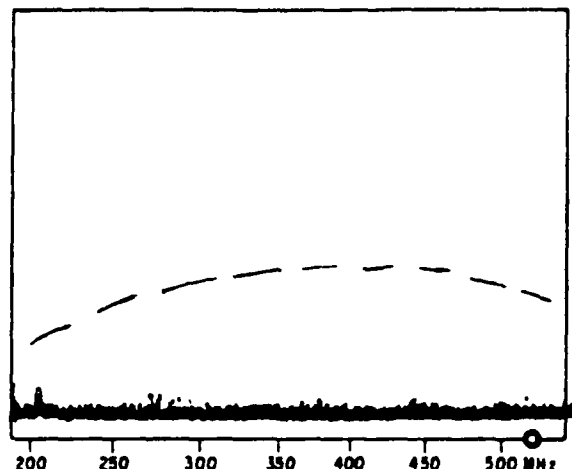
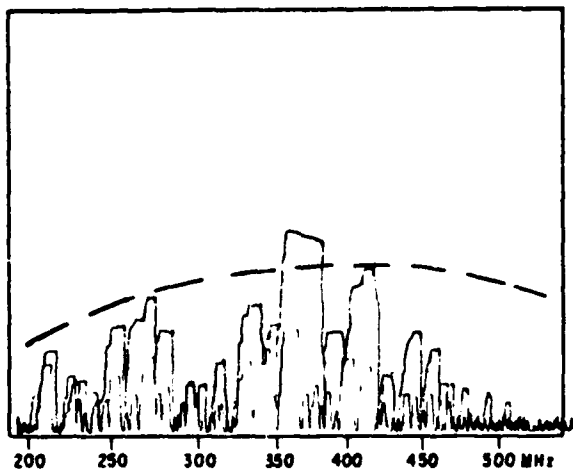


Figure 1. EMI results before (left) and after (right) modifications.

## REFERENCES

1. USAFSAM-TP-89-7, Evaluation of the Low-Profile Rigid-Mounted Cable Adapter for the MRL 450 SL-AF Cardiac Monitor, August 1989.
2. MIL-STD-461C, Electromagnetic emission and susceptibility requirements for the control of electromagnetic interference, Category A1e, 4 August 1986.



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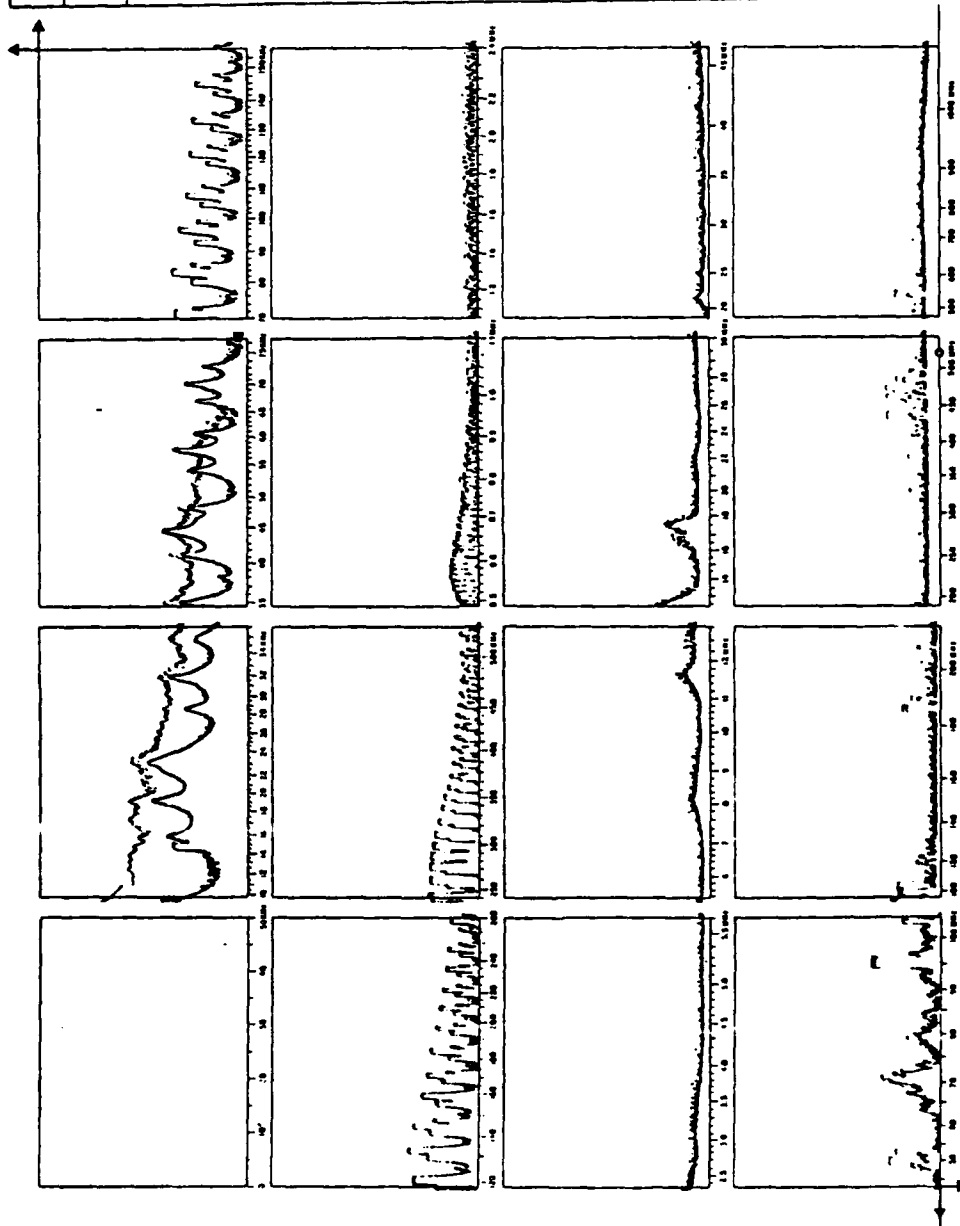
## APPENDIX

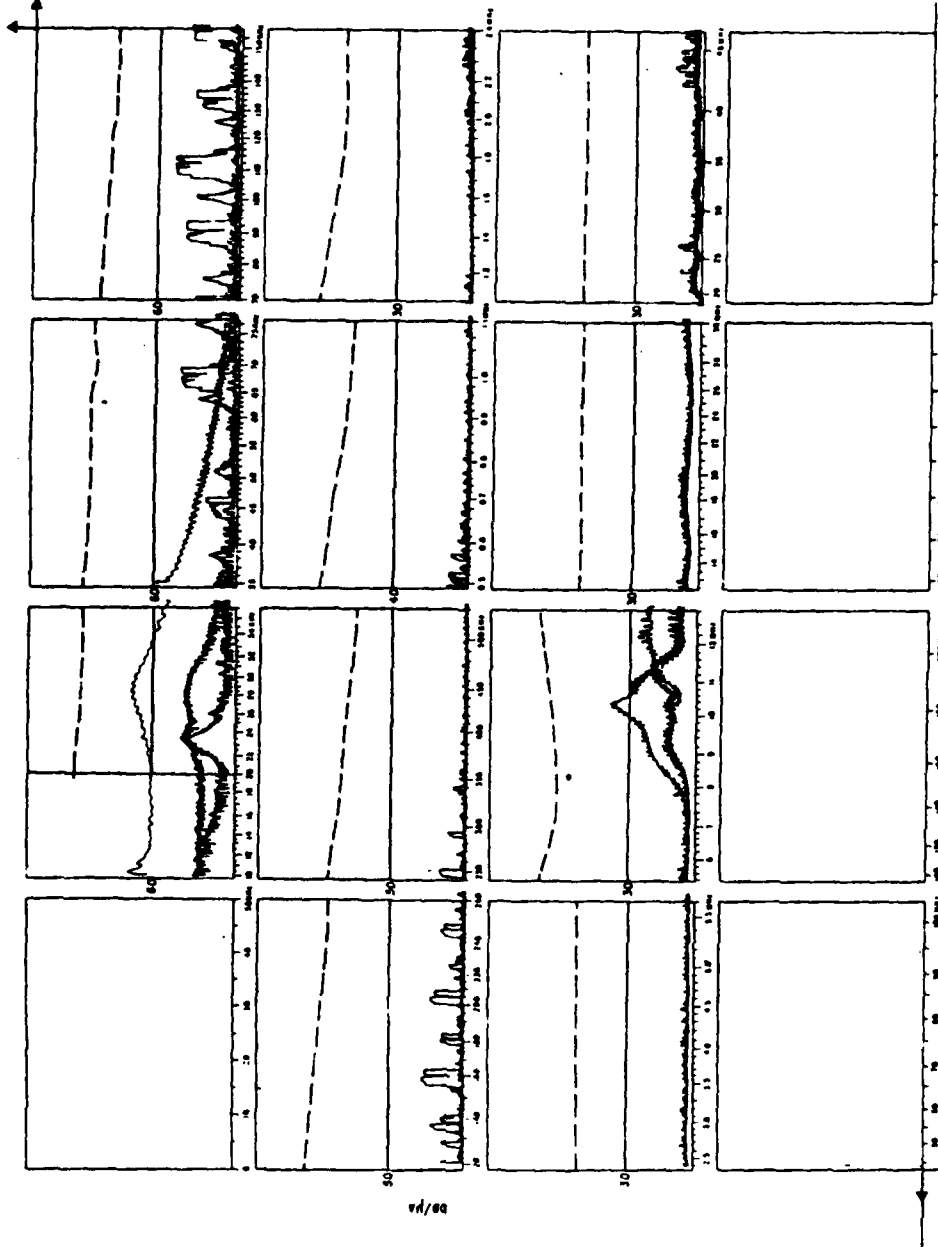
This Appendix contains copies of the original EMI charts for the tests run on the three MRL units. Each chart shows the spectral frequency range tested for that unit. The dashed lines on the charts indicate the acceptable limit for that frequency.





RADIATED EMISSION Measurement	
TEST SPECIMEN	
114.06100101-2	
420 54 05	
340 338	
TEST METHOD - 30 01	
SPECIMEN OPERATIONAL MODE - 12	
SPECIMEN POWER	
20 VDC	
110 VAC MHz <u>BLUE</u>	
110 VAC MHz <u>Red</u>	
EMITTING INTERFERENCE	
VERTICAL <input checked="" type="checkbox"/>	
HORIZONTAL <input type="checkbox"/>	
SPECIMEN PORTABLE <input checked="" type="checkbox"/> <input type="checkbox"/> NO	
COMMENTS	
114.06100101-2 420 54 05 340 338 114.06100101-2 420 54 05 340 338 114.06100101-2 420 54 05 340 338 114.06100101-2 420 54 05 340 338	
DATE TEST CONDUCTED	
11/12/87	
TEST CONDUCTED BY	
J. J. J. J.	





<b>RADIATED EMISSION</b> <small>Measurement</small>	
<b>TEST SPECIMEN</b> MSL OLF. IMITATOR 450 SL. AP 4/8 22.82	
<b>TEST METHOD - 4E 68</b>	
<b>SCAN SPEED</b> 30 SEC/1000	<b>SPECIMEN ORIGINATOR</b> NAME <u>SC</u>
<b>SPECIMEN POWER</b> IN VAC <u>RED</u> OUT VAC <u>GREEN</u> 115 VAC ON OFF 115 VAC ON OFF HORIZONTAL ANTENNA VERTICAL <input checked="" type="checkbox"/> HORIZONTAL <input type="checkbox"/> SPECIMEN PORTABLE <input checked="" type="checkbox"/> <input type="checkbox"/> NO	
<b>COMMENTS</b> OPERATIONAL NOISE 5457 KHZ CW MAP 5128 AUTO 4100 SELECT II 11500 4000 MHz CAL 2 CG SIMULATOR 100000 VIO 5110 050 100000 120 000 100000 100 000	
<b>DATE TEST CONDUCTED</b> 8/2 DEC 82	
<b>TEST CONDUCTED BY</b> Y. B. G.	

